Calibration Equipment

CONFIDENCE IS NOT ENOUGH...

Control of inspection and measuring equipment is an element of the quality management that is more important than ever before. The introduction of the ISO 9000 family of international standards has led to major changes in this field as well. Among other things, ISO 9001 specifies that:

«all inspection and measuring equipment than can affect product quality must be identified, calibrated and adjusted at prescribed intervals, or prior to use, against certified equipment having a known valid relationship to internationally or nationally recognised standards».

This standard also states that the supplier shall:
«ensure that the inspection and measuring equipment is capable of the necessary accuracy and precision».

A Big Choice

TESA can provide you with the most varied means specifically suited for inspection and calibration of standards, handtools and plug gauges. Some of them are described in the various sections of this catalogue, especially:

- *Gauge blocks*
- *Setting rings*
- *Steel balls*
- *Cylindrical setting standards with outside diameters*
- *Optical flats*
- *Plan parallel optical flats*
- *Electronic levels for both straightness and flatness measurement*
- *Instruments for both squareness and perpendicularity measurement*
- *Calibration equipment for length measuring devices fitted with inductive probes*

This section is devoted to the measuring equipment that serve to calibrate other such inspection means. But, they can also be used for high-accuracy measurement of precision parts.

The precision tool that was first developed for calibrating gauge blocks is an improved external micrometer manufactured early in the 20th century by Brown& Sharpe for the inventor of the gauge set compositions, C.E. Johansson.

Gauge Block Calibration

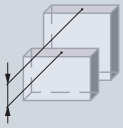
In the hierarchical chain of dimensional transfers that can be traced to the metre length unit, the gauge blocks hold a key position. And this makes them the most important material measures used in metrology.

The transference of the length unit, based on specific wavelengths of light, to gauge blocks is achieved in the first instance by a fundamental interferential measurement. From the gauge blocks measured in this way, the lengths are transferred to other gauge blocks by hierarchical measurements.

TESA Gauge Block Comparators – General Overview

TESA offer two models operating based on to two different measurement procedures.

- TESA UPD measures gauges blocks directly over a measuring span of 25 mm/1 in.
- TESA UPC is used for comparative measurement of gauge blocks having a same nominal length.

TESA Gauge Block Comparators		UPD	UPC
Measuring procedures			
Direct measurement			
• Length comparison with a variation in nominal length up to 25 mm		●	
• Number of reference gauge blocks required for calibrating a 122-piece set: 9 blocks		●	
• Number of gauges blocks required for calibrating the comparator: 9 blocks + 6 pairs of blocks		●	
Comparative measurement			
• Comparison of gauge blocks of same nominal length		●	●
• Number of reference gauge blocks required for calibrating a 122-piece set: 122 blocks		●	●
• Number of gauge blocks required for calibrating the comparator: 6 pairs		●	●
Errors of measurement			
For details about the information below, refer to both pages L-8 and L-10			
Repeatability limit	0,015 µm	●	●
	0,025 µm		●
Uncertainty of measurement	U = ± (0,05 + 0,5 · L) µm L in m	●	●
	U = ± (0,10 + 1,0 · L) µm		●
Application ranges			
Nominal lengths	0,5 to 100 mm/*0.02 to 4.0 in*	●	●
	0,5 to 500 mm/*0.02 to 20 in*	▲	▲
Measuring span			
25 mm/1 in			●
Sensors for capturing length dimensions			
• Two axial probes in sum measurement		●	●
• Digital system, opto-electronic with incremental divisions		●	
• Analogue measuring system, both electric and inductive			●
• Inductive analogue system, electric			
– electro-motorised		●	
– under the spring force			●
• Measuring bolt retraction			
– electro-motorised		●	
– by vacuum			●
Template systems (see page L-5)			
• Single template system		●	●
• Dual template system		●	❍
Handling of gauge blocks with nominal lengths up to 10 mm approx.			
Suction loader used in conjunction with the electric vacuum pump		❍	❍
TESA UPT temperature device			
Includes 4 thermal sensors (4-wire type) which measure the electric resistance		●	❍
TESA software programme for value processing			
• **TESA UP**, WINDOWS 98, 2000, NT, XP		●	●

▲ Available upon request ❍ Recommended option

TESA UPD Gauge Block Comparator with a 25 mm Measuring Span

- Direct measurement of gauge blocks with a variation in nominal length of up to 25 mm or 1 in.
  – Allows the number of required reference gauge blocks to be reduced by nearly 80%.
- Typical comparative measurement of gauge blocks having a same nominal length.
  – Enables lower measurement uncertainties to be achieved due to weaker influences of the systematic errors.
- Equipped with HEIDENHAIN high-precision incremental probes.
- Templates with a new concept for positioning the gauge blocks.
  – Single or dual template system to provide optimum ease of handling of the gauge blocks
- Integrated device for most accurate temperature acquisition.
- On-line transfer of both measured length and temperature values.
- Computer-aided data processing with all needed corrections included.

New Technical Concept through Direct Measurement

Two mutually opposed aligned probes connected in sum measurement (+A+B) also check thin gauge blocks reliably as the upper sensor A is able to capture lengths up to 25 mm. Displacement of the measuring bolt and activation of the measuring force are both electromotorised.

PT 100 platinum resistances let you capture the temperature of the two gauge blocks as well as the measuring table and support.

The TESA UP software programme processes length and temperature values as measured while executing and controlling your measurement cycles simultaneously.

General

✓

✓

EN ISO 3650

For gauge blocks with nominal lengths from 0,5 mm to 100 mm / 0.02 in to 4 in

Measuring procedures: direct and comparative measurements through the transference of the length of a reference gauge block to the gauge block to be measured.

In **direct measurement**, the nominal length of the two gauge blocks to be compared may vary up to the size of the measuring span, i.e. 25 mm.

In **comparative measurement**, comparison is always based on two gauge blocks of same nominal length.

Measuring configuration
Two probes with mechanical contact with the measuring face to be probed are connected in sum measurement (function +A+B).

Measuring points
On the reference gauge block: at the centre of the measuring face (point R). On the gauge block to be measured: at the centre (point 1) as well as the four corners of the measuring face, each lying 2 mm away from the adjacent faces (points 2 to 5). The central length l_c is determined by probing both points R and 1.
For establishing lengths at any point, the measurements shall be carried out at points R plus 1 to 5.
The variation in length v is obtained from measurements taken at points 1 to 5.

Shipping packaging

Identification number

Calibration certificate from the supplier for the comparator or the Swiss Calibration Service for the temperature device.

TESA UPD – The flexible concept that provides distinctive metrological features with substantial savings

Direct Measurement

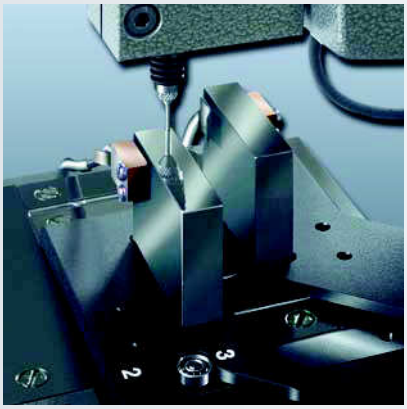
- Permits over 90% of a 122-piece set to be checked using the same reference gauge block. All nominal lengths of the full gauge set being contained within 0,5 and 25 mm, the measuring span is therefore not exceeded.
- Allows the reference gauge set to be reduced by nearly 80% against the ones needed until now.
- Provides substantial savings in the gauge block supply and recalibration through reduced set compositions.
- Enables direct measurement of gauge blocks that cannot be compared with other existing gauge blocks due to their unusual nominal lengths.

Comparative Measurement

- Allows the gauge blocks of same nominal lengths to be measured by comparison as usual.
- Enhances the measuring conditions, thus permitting all measurements to be taken with a lower uncertainty.
- Reduces the number of systematic errors through limited length related influences of both the upper probe A and the gauge block to be compared.

TESA dual template system that protects expensive reference gauge blocks (patented)

- Simultaneous use of two templates allows you to release your reference gauges until their handling becomes necessary.
- This system makes it possible for you to save time and money.
- During the measurement cycles on a routine basis, the travel length of the reference gauges over the measuring table is reduced by nearly 70%. This contributes to significantly lower the risks of damaging and wearing the measuring faces.
- The double protection of your reference gauges leads to significant cost savings by reducing the need for:
  - recalibration
  - restoring the measuring faces
  - replacing worn or damaged reference gauge blocks
  - long downtime while extending the life of your full reference gauge sets.



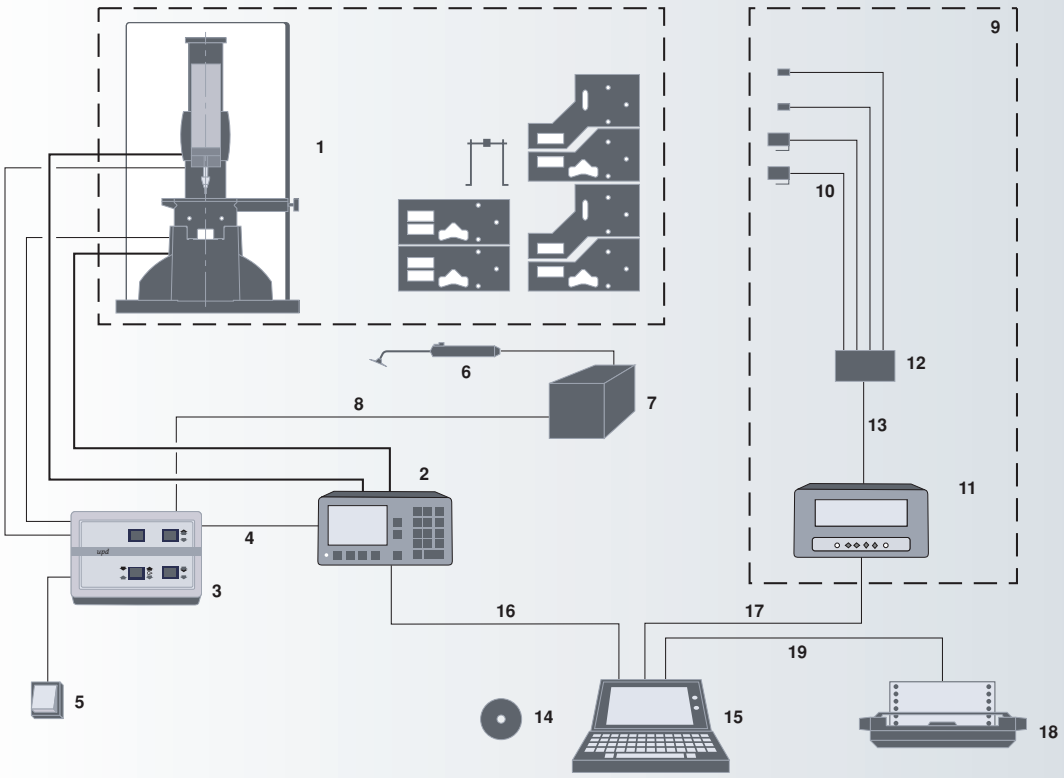
Single Template System

- With this system, your reference gauge blocks along with those to be calibrated are moved together during the measurement cycles.

TESA UPD Delivery Programme – Three Ordering Variations

	05930005	**TESA UPD gauge block comparator with temperature device***			●
	05930004	**TESA UPD gauge block comparator without temperature device***		●	
	S59300102	**TESA UPD gauge block comparator, complete* with temperature device, TESA UP software programme for value processing, PC (standard), printer**	●		
		Key components			
1	05930008	1 TESA UPD mechanical part	●	●	●
2	05960016	1 HEIDENHAIN computing counter ND 287 featuring 2 probe inputs	●	●	●
3	05960013	1 Control panel	●	●	●
4	05960014	1 Connecting cable for control panel to ND 287 computing counter	●	●	●
5	04768001	1 Foot switch	●	●	●
6	01660011	1 Suction loader	●		●
7	03260433	1 Electrical vacuum pump with external control, 230 Vac, 50 Hz	●		●
8	05960028	1 Connecting cable for electric vacuum pump to control panel	●		●
9	05930011	1 TESA UPT temperature device, complete	●		●
14	05960025	1 TESA UP software programme for value processing	●		
15	S59070014	1 Computer. For minimum requirements, refer to page L-14	●		
16	03969007	1 Connecting cable for ND 287 counter to host computer	●		
17	05960026	1 Connecting cable for temperature device to host computer	●		
18	S59070012	1 Laser printer, colour	●		
19	S59070013	1 Connecting cable for host computer to printer	●		

* Special execution for 110 Vac, 60 Hz also available on request.



Measuring stand

Heavy construction with toothed rack guide plus hand wheel for setting the measuring arm.
Fixing bores (16 and 3 mm dia, resp.) for upper probe A plus one temperature sensor No. 05960010

Main body in cast iron. Hardened steel column, dull-chrome plated and ground.

Special table

Solid measuring table fitted with 6 cylindrical pins so as to ensure and protect each handled gauge block.

3 mm diameter clamping bore for one temperature sensor No. 05960010 as well as retaining plate mounted laterally on the table for both sensors 05960008 and 05960009 fitted with clip.

Steel, hardened. Tungsten carbide pins, cylindrical.

Positioning device for gauge blocks

Single and dual template systems to shift the gauge blocks to selected measuring points.
For more details on both systems, report to the previous page.

Sensors for length measurements

Two HEIDENHAIN axial probes, opto-electronic with electro-motorised bolt activation.

ZERODUR® glass ceramic with incremental divisions

Dividing periods 4 µm

25 mm / 1 in for upper probe A.
1 mm for lower probe B.

Measuring bolt on a plain bearing

1,0 N for upper probe A.
0,63 N for lower probe B.

TESA UPD System Components

Measuring bolt in invar steel

Tungsten carbide tip with a spherical measuring face, R = 20 mm

Computing counter

HEIDENHAIN up and down computing counter ND 287 provided with two probe inputs

TFT type, 9-decade display plus sign. Also with auxiliary display for activated functions.

Signal division ≤ 400x

0,5 to 0,002 µm 0,02 to 0.0000001 in

14 mm

21 keys available for digit input as well as operating functions

Sum measurement with both probes set to +A+B. Linear correction of systematic errors. PRESET function for digit entry. 2 programmable datum points.

RS 232 and V.24

100 to 240 Vac (-15% to 10%), 50 to 60 Hz

0°C to 45°C

-30°C to 70°C

75%, non-condensing

Die-cast aluminium housing

IP40 (IEC 60529)

EN 55022, Class B

211x112x209 mm (W x H x D)

	No	
1	**05930008**	**TESA UPD Mechanical Part** *Consisting of:*
	05930009	1 Measuring stand with toothed rack guide. Manually operated for setting the measuring arm. Attachment has a 16 mm dia. fixing bore for the upper probe.
	05960015	1 Solid measuring table in special version Made from hardened steel and fitted with 6 tungsten carbide cylindrical pins for safe positioning of the gauges blocks. Provide high protection and wear resistance to the gauge blocks over many years. Threaded bores for clamping the lower probe. Prepared for the integration of the temperature sensor (see below).
	05960029	1 Positioning device provided with a single or dual template system Interchangeable templates to shift the gauge blocks from a given measuring point to another delivered as follows: 1 Pair for gauge blocks having a 9 x 30 mm cross-section. Consists of 1 template No. 05960019 for the reference gauge blocks plus 1 template No. 05960020 for the gauge blocks to be calibrated. 1 Pair for gauge blocks having a 9 x 35 mm cross-section. Consists of 1 template No. 05960021 for the reference blocks plus 1 template No. 05960022 for the blocks to be calibrated. Also with added support to prevent the blocks from tilting. 1 Template No. 05960023 for reference blocks and those to be calibrated (9x30 mm) Template No. 05960024 for the reference blocks and those to be calibrated having a 9 x 35 mm cross-section. Also with added support to prevent the gauge blocks from tilting.
	05930010	1 System for value acquisition with electro-motorised bolt activation. *Consisting of:* 1 Upper probe A, type HEIDENHAIN CT 25 (No. 05930006). Measuring span 25 mm/1 in. Measuring force 1,0 N. Fitted with probe insert No. 03510003. 1 Lower probe B, type HEIDENHAIN special (No. 05930007). Measuring span 1 mm. Measuring force 0,63 N. Fitted with probe insert No. 03510003.
	01660031	1 Setting piece for probe alignment
	01640420	1 Heat protection shield, 250 x 380 mm
	01660001	1 Pair of grip pliers for safe handling of gauge blocks
	01660030	1 Dust cover
2	**05960016**	**HEIDENHAIN Computing Counter ND 287** Up and down computing counter with LCD color monitor consisting of: 1 counter 05969029 + 1 card 05960040, each with a single entry - i.e. 2 probe entries along with 1 RS 232 data output, 100 to 240 Vac, 50 to 60 Hz.
3	**05960013**	**Control Panel** With touch keys for electro-motorised activation of the measuring bolt as well as for triggering data transfer.
4	**05960014**	**Connecting Cable** For control panel No. 05960013 to HEIDENHAIN computing counter ND 287 No. 05960016.
5	**04768001**	**Foot Switch** For fine displacement of the measuring bolt as well as data transfer.
6	**01660011**	**Pneumatic Suction Loader** For safe and easy handling of the gauge blocks with nominal length up to 10 mm. To be connected to the vacuum pump.
7		**Electrical Vacuum Pump with External Control** For the connection of the suction loader No. 01660011.
	03260433	Execution 230 Vac, 50 Hz
	S32070030	Execution 110 Vac, 60 Hz
8	**05960028**	**Connecting Cable** For vacuum pump to control panel No. 05960013.

continued next page

	Nº	
9	**05930011**	**TESA UPT temperature device for TESA Gauge Block Comparators** Fully calibrated for the measuring ranges from 19 °C up to 24 °C with a numerical interval to 0,001 °C. Supplied with a calibration certificate issued by the Swiss Calibration Service (SCS). Uncertainty of measurement achieved during calibration U = ± 0,03°C. *Consisting of:*
10	05960018	1 Set of 4 temperature sensors PT 100 platinum resistances giving exceptional long-term stability while drifts are kept to a minimum over years of use. This set includes the following single sensors: 1 Temperature sensor with clamp R for reference gauge blocks having nominal lengths from about 14 mm, No. 05960009 1 Temperature sensor with clamp P for gauge blocks to be calibrated having nominal lengths from about 14 mm, No. 05960008. 2 Temperature sensors to be mounted on the measuring stand or the table. PT 100 diameter: 3 g8 mm, 10 mm long. Order number 05960010 for 1 item.
11	05960038	1 FLUKE 1529 temperature measuring unit Precision thermometer including a switch for the measuring points. With use of the PT 100 platinum resistances, provides 4 measuring channels with a 0,001°C numerical interval. RS 232 or IEEE 488 data output, 115 or 230 Vac for 50 or 60 Hz.
12	05960012	1 Adapter For connecting up to 4 temperature sensors
13	05960011	1 Connecting cable For adapter Nº 05960012 to temperature unit Nº 05960038.
14	**05960025**	**TESA UP Software Programme for Value Processing** Running under WINDOWS 98, 2000, NT or XP. Software package including 1 CD-ROM along with 1 Hardkey. 10 languages available for function menus. For more details, see page L-14.
15	**S59070014**	**Computer** Available upon request.
16	**03969007**	**Connecting cable** For serial data transmission from HEIDENHAIN ND 287 to host computer (2 connectors 9-pin/female).
17	**05960026**	**Connecting cable** For serial data transmission from temperature device to host computer (9-pin/male and 9-pin/female).
18	**S59070012**	**Laser printer, colour** Upright A4 format. USB interface.
19	**S59070013**	**Connecting cable** For USB data transmission from host computer to printer

Errors of Measurement

Provided all metrological conditions are met, the reliability of the comparator used for direct measurement of steel gauge blocks is expressed as follows:

Repeatability limit (with no influence of external temperature): 0,015 µm

Uncertainty of measurement:
U = ± (0,05+0,5·L) µm (L en m)

Condition requires the use of reference standards whose measurement uncertainty is equal to

U ≤ ± 0,015 µm
for the comparator

U ≤ ± (0,02 + 0,2·L) µm (L in m)
for the gauge blocks

Temperature Sensors
4 PT 100 platinum resistances, 4-wire type

Temperature Device
Multiple-channel precision thermometer. Also equipped with a switch for the measuring points.

Procedure: 4-wire resistance measurement with continuous value acquisition through connected sensors. PT 100 linearisation according to EN 60751.

Alphanumeric LC display with background lighting

0,001°C

°C, °F or K

8 mm

6 keys available for the functions

RS 232 and IEEE 488

115 ±10% Vac or 230 ±10% Vac, for 50 and 60 pHz

5°C to 40°C

-25°C to 60°C

75%, non-condensing

EN 61010, EN 50081, EN 50082 and EN 55011

191 x 102 x 208 mm (W x H x D)

General

✓

EN ISO 3650

For gauge blocks ranging from 0,5 mm to 100 mm or 0.02 in to 4 in

Comparative measurement procedure
with transference of the length of a reference gauge block to the gauge block being measured.

Measuring configuration
2 probes connected in sum measurement (function +A+B) with mechanical contact with the measuring face.

Measuring points
On the reference gauge block: at the centre of the measuring face (point R).
On the gauge block to be measured: at the centre (point 1) as well as the 4 corners of the measuring face, each lying 2 mm away from the adjacent faces (points 2 to 5).

Central length l_c is defined by probing both points R and 1. Establishing lengths at any point requires measurements to be taken at points R plus 1 to 5.

Variation in length v is the result of measurements taken at points 1 to 5.

TESA UPC Gauge Block Comparator for Comparative Measurement

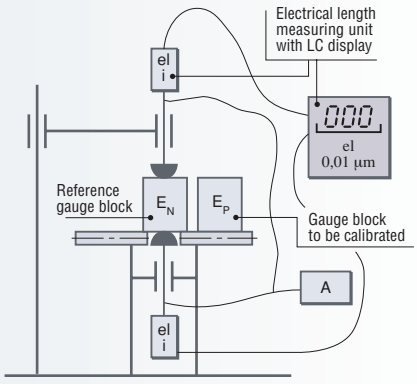
- Measures gauge blocks of same nominal length by comparison.
- Comes with the new template system for positioning the gauge blocks.
  – Single or dual template system for optimum ease of gauge handling.
- Features TESA high-precision inductive probes.
- Allows ultra-precise temperature measurement, integrated.
- Transfers on-line all measured length and temperature values.
- Executes computer-aided data processing with all needed correction values included.
- Performs calibrations that meet the requirements of both ISO standards and EA guidelines (EAL – European cooperation for Accreditation of Laboratories).
- Includes an execution for greater accuracy along with a calibration certificate (optional).

TESA UPC is specially designed for the calibration – or dimensional inspection – of gauge blocks with nominal lengths ranging from 0,5 to 100 mm. The configuration, which consists of two probes aligned opposite one another, associated with both the concept and quality of the measuring system provides full guarantee for an extra low uncertainty of measurement.

Although TESA UPC is mainly intended for manufacturers and end-users of gauge blocks, this comparator is also widely used in nationally accredited laboratories.

If specified, TESA can also provide the temperature device available as an option. This device has 4 PT100 platinum resistances, each capturing the temperature of the two gauge blocks along with that of both the measuring table and the support.

Computer-aided data processing lets you carry out any calibration most reliably and rationally – for sure.



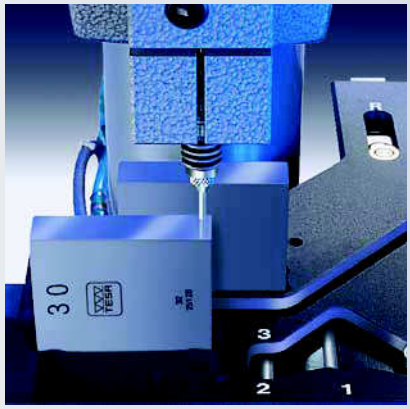
Single Template System

- With this system, your reference gauge blocks along with those to be calibrated are moved all together throughout the measurement cycle.

Dual Template System

(TESA Patent)

- The use of two templates instead of a single one allows you to leave your reference gauge blocks aside until their handling becomes necessary.



Errors of Measurement

Provided all the metrological conditions are met, the reliability of the two standard executions No. 05930000 and 05930002 is expressed as follows:

Repeatability limit (with no effect due to external temperature): 0,025 µm

Measurement uncertainty*
U=±(0,10+1,0·L) µm (L in m)

Condition involves the use of reference standards (see pages L-14 and L-15) whose uncertainty is as follows:

U ≤ ± 0,030 µm
when calibrating the comparator

U ≤ ± (0,05 + 0,5 · L) µm (L in m)
when calibrating the gauge blocks

** Applicable to steel gauge blocks*

Provided all the metrological conditions are met, the reliability of both executions No. 05930001 and 05930003 along with the option for greater accuracy (No. 01690021) is expressed as follows:

Repeatability limit (with no effect due to external temperature): 0,015 µm

Measurement uncertainty*
U = ± (0,05+0,5·L) µm (L en m)

Condition involves the use of reference standards (see pages L-14 and L-15) whose uncertainty is as follows:

U ≤ ± 0,015 µm
when calibrating the comparator

U ≤ ± (0,02 + 0,2 · L) µm (L in m)
when calibrating the gauge blocks

** Applicable to steel gauge blocks*

Measuring stand

Heavy construction with toothed rack guide plus handwheel for coarse setting of the measuring arm.
Encapsulated attachment plus device for extra-fine setting of upper probe A.
3 mm dia. fixing bore for one temperature sensor No. 05960010.

Main body in cast iron. Column in hardened steel, dull-chrome plated and ground.

Special table

Solid measuring table fitted with 6 cylindrical pins to ensure and protect the gauge blocks as they are being handled.
3 mm dia.clamping bore for one temperature sensor No. 05960010 as well as retaining plate mounted laterally on the table for both sensors No. 05960008 and 05960009 with clip.

Hardened steel. Tungsten carbide cylindrical pins.

Positioning device

Single and dual template systems to shift the blocks to predefined measuring point.

For further details on both template systems, report to page L-5 as well as to System components on page L-12.

Sensors for length values

2 TESA GT 22-spec. inductive probes with pneumatic retraction of the measuring bolt.
Electrical adjustment through resistances fitted on each probe

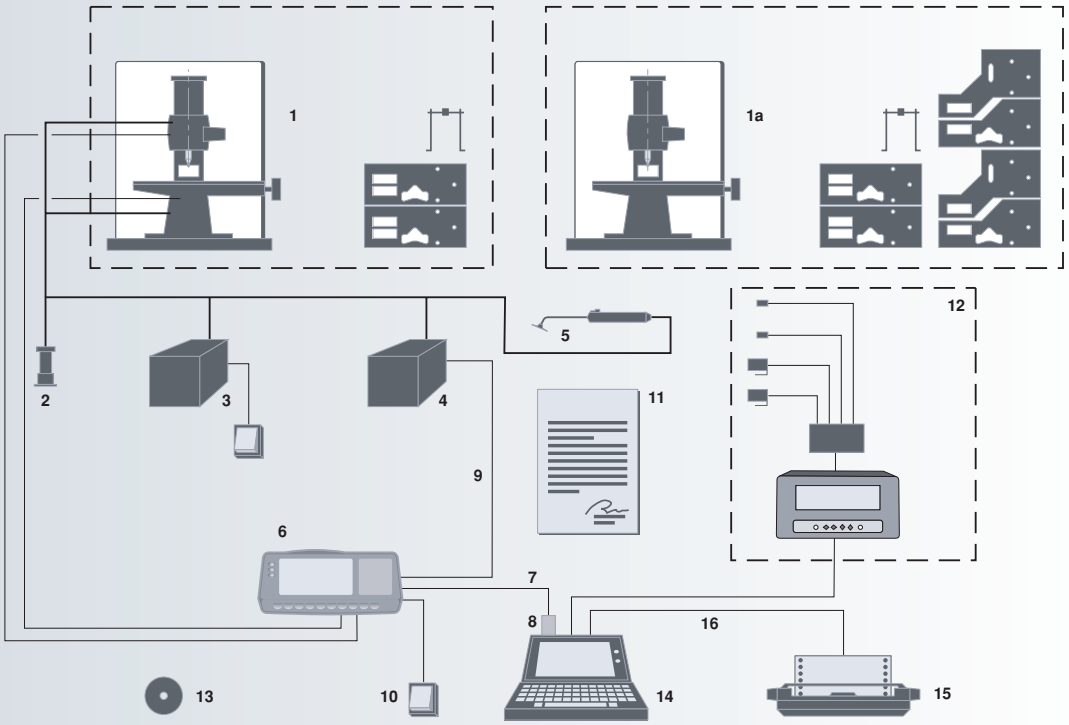
± 150 µm measuring travel

Upper probe A ≈ 1N, lower probe B ≈ 0,63 N

Tungsten carbide insert with spherical measuring face, R = 20 mm

TESA UPC Delivery Programme – Eight Ordering Variations

TESA UPC gauge block comparator equipped with single template system										
	05930000	**Standard execution, without computer application**								●
	05930001	**Execution for greater accuracy, without computer application**							●	
	05930002	**Standard execution, with computer application**						●		
	05930003	**Execution for greater accuracy, with computer application**					●			
TESA UPC gauge block comparator equipped with single and dual template system										
	05930012	**Standard execution, without computer application**				●				
	05930013	**Execution for greater accuracy, without computer application**			●					
	05930014	**Standard execution, with computer application**		●						
	05930015	**Execution for greater accuracy, with computer application**	●							
Each version consists of:										
1	**01610401**	**1 TESA UPC mechanical part** Equipped with the single template system					●	●	●	●
1a	**05960030**	**1 TESA UPC mechanical part** Equipped with the single and dual template system	●	●	●	●				
2	**03260401**	1 Pneumatic retraction of the measuring bolt, manually operated				●				●
3	**03260432**	1 Electric vacuum pump with foot switch			●				●	
4	**03260433**	1 Electric vacuum pump with external control	●	●			●	●		
5	**01660011**	1 Pneumatic suction loader	●	●	●		●	●	●	
6	**04430012**	1 TESATRONIC electronic unit TT90	●	●	●	●	●	●	●	●
	05960039	1 Set of TESA UPC accessories, including the components listed under 7,8,9								
7	**04761049**	1 Opto-RS cable, bidirectional	●	●			●	●		
8	**04760087**	1 Opto-RS interface	●	●			●	●		
9	**04761070**	1 Connecting cable TESATRONIC TT90 to vacuum pump	●	●			●	●		
10	**04768000**	1 Hand switch	●	●			●	●		
11	**01690021**	1 Option for greater accuracy with calibration certificate	●		●		●		●	



TESATRONIC TT90

- 6-decade display plus negative sign
- Used range: ±20 µm
- 0,001 µm or 0.05 µin
- 6,6 mm
- RS 232 data output, opto-coupled

TESA UPC System Components

	№	=
1	**01610401**	**TESA UPC mechanical part provided with single template system** Prepared for mounting the TESA UPT temperature device *Consisting of:*
	01630004	1 Measuring stand with toothed rack guide Manually operated for coarse setting of the measuring arm. Encapsulated attachment and device allowing extra-fine setting of the upper probe.
	05960031	1 Special solid measuring table Made from hardened steel and fitted with 6 carbide cylindrical pins for a safe positioning. Provides high protection and wear resistance to the gauge blocks over years. Adjustable attachment for lower probe B. Prepared for the integration of the temperature sensors.
	05960032	1 Single template system Used to shift the gauge blocks from a given point to another. Interchangeable templates No. 01660045 (for gauge blocks 9 x 30 mm) and No. 01660046 (for gauge blocks 9 x 35 mm). Also with added support to prevent them from tilting.
	03230045	1 Sensor system for value acquisition consisting of: – Upper probe A, GT 22-spec. No. 03290075. Measuring force to 1 N. Fitted with the measuring insert No. 03510003. – Lower probe B, GT 22-spec. No. 03290076. Measuring force to 0,63 N. Fitted with the measuring insert No. 03510003. – Air pipe system
	01660031	1 Setting piece for probe alignment
	01640420	1 Heat protection shield, 250 x 380 mm in size.
	01660001	1 Pair of grip pliers for safe handling of gauge blocks
	01660030	1 Dust cover
1a	**05960030**	**TESA UPC mechanical part provided with the single and dual template system** Prepared for mounting the TESA UPT temperature device *Includes the same components as described under the first item above, except for:*
	05960029	1 Single and dual template system for positioning the gauge blocks including: 1 Pair of templates for gauge blocks 9 x 30 mm with 1 item No. 05960019 for the reference blocks and 1 item No. 05960020 for the gauge blocks to be calibrated. 1 Pair of templates for gauge blocks 9 x 35 mm with 1 item No. 05960021 for the reference blocks and 1 item No. 05960022 for the gauge blocks to be calibrated. Also with added support to prevent tilting. 1 Template No. 05960023 for the reference blocks and those to be calibrated, 9x30 mm. 1 Template No. 05960024 for the reference blocks and those to be calibrated, 9x35 mm Also with added support to prevent the gauges tilting.
2	**03260401**	**Pneumatic retraction of the measuring bolt** Manually operated
3	**03260432**	**Electric vacuum pump with foot switch** For retracting the measuring bolt of each probe. Also used to plug the hand-operated pneumatic suction loader No. 01660011, 230 V.
4	**03260433**	**Electrical vacuum pump with external control** Connected to the measuring unit TT90 No. 044430012. Used for the retraction of the measuring bolt of each probe. Also used to plug the suction loader No. 01660011, 230 V.
5	**01660011**	**Pneumatic suction loader** For safe, easy handling of gauge blocks with nominal lengths up to 10 mm. Connected to the electric vacuum pump No. 03260432 or No. 03260433.
6	**04430012**	**TESATRONIC length measuring instrument TT90** For a detailed description, see chapter O.

0°C to 60°C

-10°C to 70°C

80%, non-condensing

Battery charger 100 to 240 V, 50 to 60 Hz. Nominal output voltage: 7,3 V

Electric vacuum pump

No. 03260432 or 03260433 = 230 Vac, 50 Hz

Temperature device

See page L-8

Additional data

≈ 23 kg (comparator complete, but without computer).
≈ 4 kg (temperature device)

Shipping packaging

Each execution with the option for greater accuracy is provided with serial number

In-house calibration certificate for the version with greater accuracy or declaration of conformity for the standard version.

Temperature device with SCS certificate.

Electric vacuum pump in special version

With external control as for No. 03260433, except:

110 Vac, 60 Hz

№ **S32070030**

	05960039	**Set of TESA UPC accessories** *consisting of:* Components as listed under items 7, 8 and 9 below.
7	**04761049**	**Opto-RS cable, bidirectional** For serial data transfer.
8	**04760087**	**Opto-RS interface** For Opto-RS cable to RS 232 PC port.
9	**04761070**	**Connecting cable** For electronic unit TT90 (No. 04430012) to vacuum pump (No. 03260433)
10	**04768000**	**Hand switch** Used for triggering any movement of the measuring bolt along with data transfer from TESATRONIC TT90 (No. 04430012) to host computer. Direct connection to the electronic unit.
11	**01690021**	**Option for greater accuracy and calibration certificate** Consists of TESA UPC (mechanical part No. 01610401 together with TESATRONIC TT90 specially adjusted and calibrated. All key components are marked with serial number.
12	**05930011**	**TESA UPT temperature device for TESA gauge block comparators** Fully calibrated for the measuring ranges from 19°C up to 24°C with a numerical interval to 0,001°C. Supplied with a calibration certificate issued by the Swiss Calibration Service (SCS). Uncertainty of measurement achieved during calibration U = ± 0,03 °C. Used in association with TESA UP software programme for value processing. *Consisting of:*
	05960018	1 Set of 4 temperature sensors
	05960038	1 FLUKE 1529 temperature device
	05960012	1 Adapter
	05960011	1 Connecting cable For a detailed description, refer page L-15.
13	**05960025**	**TESA UP software programme for value processing** Running under **WINDOWS 98, 2000, NT or XP** • For details on the programme related features, report to page L-14.
14	**S59070014**	**Computer** Available upon request. For minimum requirements, see page L-14.
15	**S59070012**	**Laser Printer, colour** Upright A4 format. USB interface.
16	**S59070013**	**Connecting cable** For USB data transmission between host computer to printer.

Hardware

All hardware components listed opposite (items 14 to 16) can be purchased locally. Should you wish to, we may also provide you with a quotation on request.
TESA cannot assure the UP system will operate properly when run on a network. Therefore, we recommend to inquire about a technical information before purchasing your own equipment.

TESA UP Software Programme for Value Processing

Suitable for both TESA gauge block comparators UPD and UPC as well as for comparators from other manufacturers.

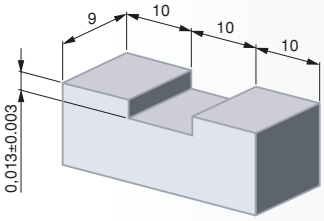
- Choice of 10 languages.
- On-line processing of length and temperature values as transferred.
- Measurement cycles and result outputs according to EN ISO 3650.
- Flexible architecture for optimum adaptation to specific User's needs.
- Possible entry of limit values and accuracy grades peculiar to Users.
- Surveillance of value dispersion or value drift throughout length and temperature measurements.
- Automatic execution of all relevant corrections. The programme makes allowances for actual sizes of the reference standards, flattening due to different materials used (steel, tungsten carbide, ceramic), compensation of temperature variations with reference to 20°C according to the varying coefficients of linear expansion – as typical examples.
- Assignment of gauge blocks to their relevant grade.
- Possible storage of gauge block set related data.
- Inch or metric value processing.
- Calibration certificate in various versions.

No	
05960025	**TESA UP software programme for gauge block calibration** Running under WINDOWS 98, 2000, NT, XP *Software package including:* 1 CD-ROM plus 1 USB protective Hard-key

✓
EN ISO 3650
Metric/Inch units

Minimum profile requirements for the computer needed to run the TESA UP software programme

Personal Computer
- Configuration without heat source to avoid disturbing the ambient temperature at the measurement spot.
- Operating system: Windows 98, 2000, NT or XP
- Processor: 650 MHz
- 1 Hard disc (6 GB)
- RAM capacity: 64 MB
- CD-ROM drive (24x)
- RS 232 serial port
  1 for length values
  1 for temperature values
- USB port



Gauge Blocks for the Calibration of Comparators

To calibrate both TESA gauge block comparators UPD and UPC, we recommend the use of the gauge block set described hereafter. The 9-piece set listed on page L-15 is additionally required for calibrating TESA UPD.

Set Composition Including 11 Gauge Blocks

Each pair is in full compliance with:

- EAL-G21 – Calibration of Gauge Block Comparators – European cooperation for Accreditation of Laboratories
- DKD-R 4-1 – Guidelines of the German Calibration Service (DKD) for the calibration of gauge block comparators.

No		µm
	Set of 11 gauge blocks for calibrating each comparator	
	Set composition as listed in the chart opposite. Supplied with:	
S59110152	Calibration certificate issued by the Physikalisch Technische Bundesanstalt (PTB)	**± 0,015**
S59110489	Calibration certificate issued by a laboratory accredited by the German calibration service (DKD)	± 0,030

Full tungsten carbide set also available on request

Pairs N°	Nominal length A mm	B mm
1	0,5	0,5
2	1,0	1,005
3	1,0	1,01
4	4,0	4,0
5	100,0	100,0
6	6,0	6,0*

* Special bridge-shaped gauge blocks (see drawing) used for establishing the measuring deviations of lower probe B.

✓
EN ISO 3650
Special high-alloy steel, wear resistant and stable. Exception: 6 mm special carbide gauge blocks.
Class K
The given expanded uncertainty k = 3 refers to the difference of central length of both gauge blocks A and B forming the pairs 1 to 5 as well as to the deviations f_o and f_u from the central length of gauge blocks forming both pairs 2 and 3. No need to calibrate those of pair No. 6.
Wooden case
Identification number
PTB or DKD calibration certificate

✓

✓

EN ISO 3650

Special high-alloy steel, wear resistant and stable

Grade K

Expanded uncertainty k = 2 is valid for the given one

Wooden case

Identification number

For calibration certificates, see opposite

Additional Gauge Block Set for the Calibration of TESA UPD

To achieve the lowest uncertainty of measurement, we recommend the use of reference standards of grade K, which are measured directly by interferometry and come along with a calibration certificate. And this, irrespective of any other requirement such as the ambient conditions.

№		µm
	9-piece gauge set for the calibration of TESA UPD *Set composition as listed in table opposite. Supplied with:*	
S59300103 **S59300107**	Calibration certificate issued by the laboratory of a national institute of metrology Metas (Switzerland) PTB (Germany)	±(0,02+0,2·L) µm L in m Measuring method: direct inteferometry
S59300104	Calibration certificate issued by a laboratory officially accredited SCS	±(0,05+0,5·L) µm L in m Measuring method: by comparison

Set Composition (mm)
1 5 10 15 20 25 50 75 100

Steel

Accuracy grade K

Other set compositions or carbide gauge blocks also available on request.

✓

Temperature Sensors

PT 100 platinum resistances, 4-wire type

Temperature Device

Multi-channel precision thermometer equipped with a switch for the measuring points

4-wire measuring method with continuous value acquisition over connected sensors.
PT100 linearisation according to EN 60751.

0,001 °C

RS 232 or IEEE 488

115 ±10% Vac or 230 ±10% Vac. For 50 and 60 Hz

EN 61010, EN 50081, EN 50082 EN 55011

Additional technical data listed on page L-8

TESA UPT Temperature Devices

№	
05930011	**TESA UPT temperature device for TESA Gauge Block Comparators** Fully calibrated for the measuring ranges from 19°C up to 24°C with a numerical interval to 0,001 °C. Supplied with a calibration certificate issued by the Swiss Calibration Service (SCS). Uncertainty of measurement achieved during calibration U = ± 0,03°C. *Consisting of:*
05960018	1 Set of 4 temperature sensors PT100 platinum resistances giving exceptional long-term stability while drifts are kept to a minimum over years of use. This set includes the following sensors: 1 Temperature sensor with clamp R for reference gauge blocks having nominal lengths from about 14 mm, No. 05960009. 1 Temperature sensor with clamp P for gauge blocks to be calibrated having nominal lengths from about 14 mm, No. 05960008 2 Temperature sensors mounted on the measuring stand or the table. PT 100 sensors. 3 g8 in diameter, 10 mm long. Order number for a single item: 05960010.
05960038	1 FLUKE 1529 measuring unit for temperature Precision thermometer including a switch for the measuring points. With use of the PT 100 platinum resistances, provides 4 measuring channels with a 0,001 °C numerical interval.RS 232 or IEEE 488 data output. 115 or 230 Vac for 50 or 60 Hz.
05960012	1 Adapter. Allows up to 4 temperature sensors to be connected.
05960011	1 Connecting cable For adapter No 05960012 to measuring unit No 05960038.
05960026	**Connecting cable** For serial data transfer from temperature device to computer, 9-pin/m and 9-pin/f connector.

ETALON POLO
Horizontal Measuring Bench

A giant for small sizes – Specially designed for the control of measuring and test equipment in compliance with ISO 9000.

- Application range from 0 up to 100 mm for external dimensions or 2,5 up to 110 mm for internal dimensions – 50 mm measuring span.
- Resolution to 0,001 or 0,0001 mm – Metric/Inch conversion.
- Maximum permissible error of 0,5 µm.
- Measuring force from 0 to 4 N.
- Comes with a calibration certificate issued by the supplier.

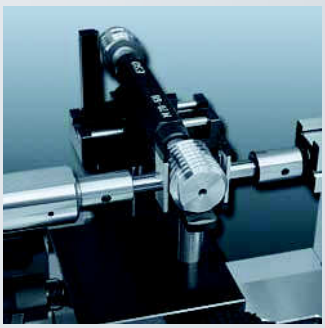
✓
✓
Shipping packaging
Identification number
In-house calibration certificate

Calibration of Standards

- Cylindrical test pins
- Setting standards with cylindrical, plane-parallel measuring faces
- Threaded reference gauges (calibrated using the 3-wire method)
- Setting masters
- Setting rings

Calibration of Plug Gauges

- Limit plug gauges
- Plug gauges «GO»
- Plug gauges «NOT GO»
- Plain plug gauges
- Ring gauges «GO»
- Ring gauges «NOT GO»
- Threaded plug gauges



ETALON POLO
Measuring Bench

✓

0 to 100 mm for external dimensions
• 10 to 110 mm with standard accessories

• 2,5 to 110 mm with optional accessories

50 mm measuring span

Max. perm. error within the measuring span: 0,5 µm with standard accessories

0,1 µm

0 to 4 N

Opto-electronic measuring system with incremental glass scale, type LIF – HEIDENHAIN

8,0 • 10^{-6}/°C

Tilting range of the floating table ± 0,5°

See on drawing
• shortest distance A = 0 mm
• longest distance A = 11,5 mm

19,0 kg net net
(main part alone, without table)
2,8 kg net (floating table)
2,1 kg net (fixed table)

10°C to 40°C

--10°C to 40°C

EN 50081-1
EN 50082-2
EN 61000-4-2
EN 61000-4-4

Calibration of Hand-Held Tools

- Dial gauges
- Precision indicators
- Dial test indicators (lever-type)
- Electronic probes

ETALON POLO with Floating Resting Table

05939001	**ETALON POLO measuring bench with floating resting table and HEIDENHAIN computing counter ND 287 included.**

Consists of the following main components:

05919002	**1 Main part** Application range 0 to 100 mm for external dimensions or 10 to 110 mm for internal dimensions (with standard accessories). 50 mm measuring span. Base plate with measuring unit and mounting block for the fixed meas uring stops fitted with a stop pin; measuring unit equipped with a spindle as well as opto-electronic system featuring an incremental glass scale. Stop pin and spindle have both a mounting bore for a 6,5 mm dia. meas uring insert; attachment for the stops and measuring device allowing the table to be moved vertically, and then tilted for inside measurements. Also with adjust system for the measuring force.
05969024	**1 Pair of standard measuring inserts for external dimensions** With a 6,5 mm dia. tungsten carbide flat face, already mounted.
05969015	**1 Floating resting table** Already mounted, also interchangeable. Used for positioning parts in the measuring direction when inspecting internal dimensions. Includes a stainless steel plate, hardened and ground, mounted on ball bearings. 200 x 100 mm table surface area, also with mount for the limit stops.
05969029	**1 HEIDENHAIN computing counter ND 287** Up/down counter with LCD color display. Switchable from metric to inch. Captures both extreme values with output of the difference between these values. Value classification capability. RS 232 data output.

Supplied with the following standard accessories:

05969020	**1 Pair of standard inserts for internal dimensions from 10 mm** Stainless steel measuring face, hardened and ground. Ball tip section R = 2,5 mm. M4 locking screw.
05969030	**1 Dust cover**

ETALON POLO with Fixed Resting Table

05939000	**ETALON POLO measuring bench with fixed resting table and HEIDENHAIN computing counter ND 287 included**

Consists of the following components:

05919002	**1 Main part** As described on the previous page.
05969024	**1 Pair of standard measuring inserts for external dimensions** With a 6,5 mm dia. carbide flat measuring face, already mounted.
05969014	**1 Fixed resting table** Already mounted, also interchangeable. Used for internal measurements. Includes a stainless steel base plate, hardened and ground. Table surface 200 x 100 mm. Also with stop clamp for positioning the workpiece.
05969029	**1 HEIDENHAIN computing counter ND 287** Up/down counter with LCD color display. Switchable from metric to inch. Captures extreme values with output of the difference between both. Value classification capability. RS 232 data output.

Supplied with the following standard accessories:

05969016	**1 Single pair of standard inserts for internal dimensions from 10 mm**
05969030	**1 Dust cover**

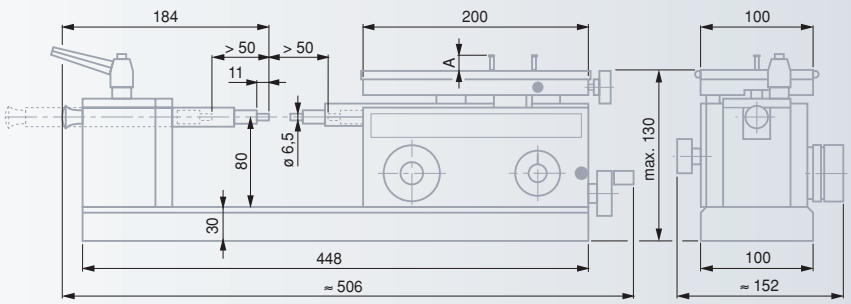
Workpiece Inspection

External dimensions

- Stepped shafts
- Cutting tools
- Cylindrical pins
- Ball tips
- Grooves
- Short centring shoulders
- Threads (measured according to the 3-wire method)

Internal dimensions

- Through bores
- Blind bores
- Centring grooves
- Slots
- Sliding guides



HEIDENHAIN ND 287 Computing Counter

- ✓
- Up/down counter for inner data processing and output
- TFT display screen, 9-decade plus sign. Auxiliary display for active functions.
- 0,001 and 0,0001 mm or 0.0001 and 0.00001 in
- 14 mm
- RS 232
- 0°C to 45°C
- -30°C to 70°C
- 75%
- 100 to 240 Vac (-15% to +10%), 50 to 60 Hz
- 211 x 112 x 209 mm (L x H x D)
- ≈ 2,5 kg
- IP40 (IEC 60529)
- Noise acuteness to grade 4 (VDE 0843, Parts 2 and 4)
- EN 55022, class B

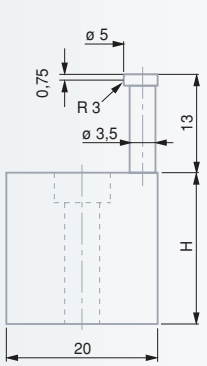
✓ Shipping packaging

Standard Accessories

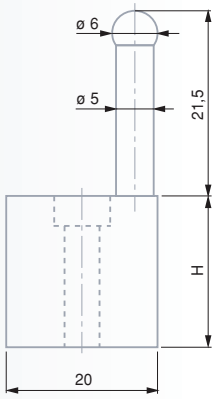
Available according to the model supplied.

No	
05969024	**1 Pair of standard measuring inserts for external dimensions** 6,5 mm dia. carbide inserts with a flat face
	Standard measuring inserts for internal dimensions from 10 mm 5 mm dia. inserts with stainless steel measuring face, hardened. M4 locking screw.
05969020	1 Pair of inserts for use with the floating table No. 05960015, H = 20 mm.
05969016	1 Pair of inserts for use with the fixed table No. 05969014, H = 12,5 mm.

05969024



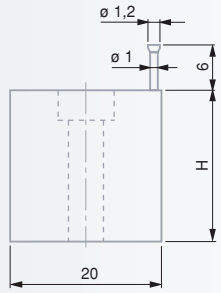
05969016-20



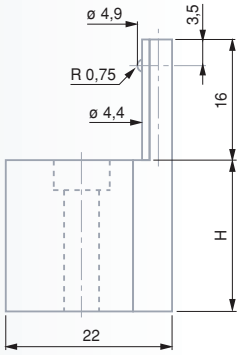
05969018-22

Optional Accessories

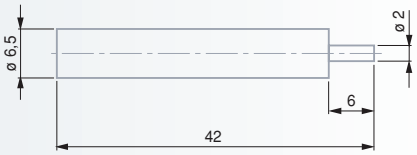
No	
	Measuring inserts for internal measurement using the floating resting table Height H = 20 mm. M4 locking screw.
05969021	**1 Pair for internal dimensions from 2,5 mm** Barrel-shaped inserts with a 1,2 mm dia. carbide ball tip.
05969023	**1 Pair for internal dimensions from 5 mm** Fitted with a 1,5 mm dia. carbide ball tip.
05969022	**1 Pair for internal dimensions from 13 mm** Fitted with a 6 mm dia. carbide ball tip.
	Measuring inserts for internal measurements using the fixed resting table Height H = 12,5 mm. M4 locking screw.
05969017	**1 Pair for internal dimensions from 2,5 mm** Barrel-shaped inserts, with a 1,2 mm dia. carbide ball tip.
05969019	**1 Pair for internal dimensions from 5 mm** Fitted with a 1,5 mm dia. carbide ball tip.
05969018	**1 Pair for internal dimensions from 13 mm** Fitted with a 6 mm dia. carbide ball tip.
05969028	**1 Pair for external dimensions** Tungsten carbide flat measuring face, D = 2 mm.
05969027	**1 Pair for external dimensions** Tungsten carbide flat measuring face, D = 8 mm.
	Attachments for the measuring inserts
05969025	with mounting thread G = M2,5
05969026	G = 4/48 in
	Inserts with special design available on request
	Inserts with M2,5 thread, see pages F-42 to F-44.
	Wires for thread measurement, see page C-24.



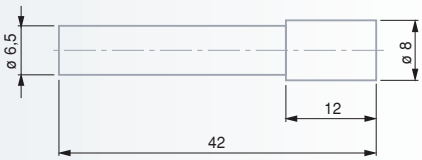
05969017-21



05969019-23



05969028



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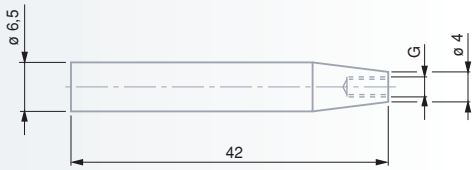
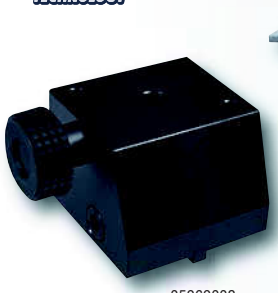


05969025/26

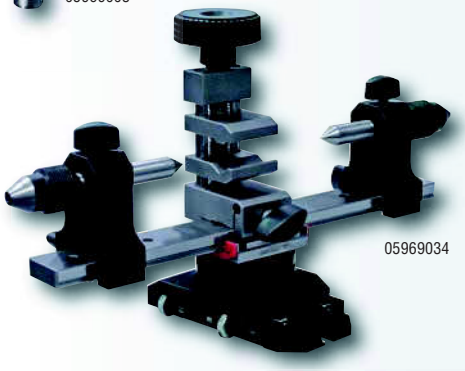
No	
05969000	**Bench stand with swivelling plate** For raising the measuring bench from horizontal to vertical position. Accommodates a clamp lever. Length (upright): 295 mm, mass ≈ 20 kg.



05969002

05969001

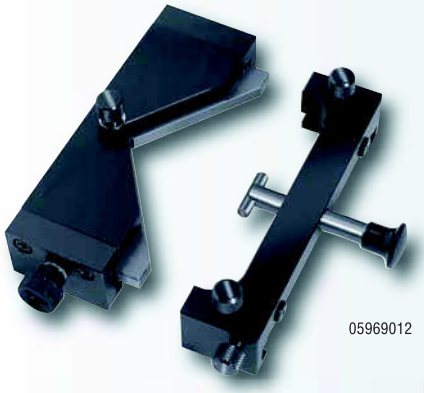
05969003



05969034

05969005

05969007/8



05969012

05969010

05969004

05969009

05969001	**Base for the computing counter** For heightening the HEIDENHAIN computing counter ND 287 up to 380 mm, mass 5,2 kg.
	Intermediate resting block Features a 10 mm dia.mounting bore for: • resting table No. 05969003 • Holder No. 05969004 for a dial test indicator (lever-type)
	Supporting plate Used for external measurement. 60 x 60 mm surface area with recesses. Hardened, ground steel. Also with a 10 mm dia. fixing pin.
05969034	**Floating resting table** Used for external measurement on oblong parts up to 60 mm in diameter; centres, L=160 mm; movable positioning fixture for parts having varying lengths, 3 freedom degrees. *Consisting of:*
05969032	Resting table with centres
05969033	Vise support for cylindrical test pins
05969005	**Intermediate resting block** Used in conjunction with the floating mount device No. 05969013.
05969012	**Centring device** Allows to search for the transverse culmination point against the measuring direction. Used with either of both fixed or floating table No. 05969014 or 05969015. Prismatic stop adjustable transversely, max. diameter 110 mm. Counterpressure piece finished with cylindrical stop pins.
	Clamping rods For clamping the instruments that need be calibrated such as dial gauges or precision indicators.
05969010	For fixing shafts with a 8 mm dia.
05969011	$^{3}/_{8}$ in dia.
05969004	**Holder** **for a dial test indicator (lever-type)r** Provided with 2 dovetail clamps, TESATAST-type or in compliance with BS 2795:1981.
05969009	**Spindle for calibrating dial gauges, dial test indicators and the like** Setting range = 50 mm, Spindle rotation = 0,5 mm

✓ Shipping packaging